MTM

THE JOURNAL OF METHODS-TIME MEASUREMENT

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In This Issue . . . . .

A 1955 New Look at MTM

An Approach to Application of Eye Time

MTM ASSOCIATION FOR STANDARDS AND RESEARCH

The Journal of Methods-Time Measurement is dedicated to the technical aspects, application developments and general news items concerning the advancement of MTM.

The Journal encompasses the fields of endeavor that were formerly publicized in the MTM Newsletter and MTM Bulletin.

The technical section of the Journal is concerned chiefly with recent research developments both from the established research program at the University of Michigan, Ann Arbor, Michigan, and from somewhat smaller allied projects being conducted throughout the Association membership.

New applications of MTM as well as refinements of established applications are presented in the Application Section to illustrate specific approaches to management problems that can be solved through the use of Methods-Time Measurement.

Current events in the lives of persons associated with MTM are described in the general news section.

The Editorial Staff welcomes contributions for all three sections described.

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MTM ASSOCIATION FOR STANDARDS AND RESEARCH

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1955

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FEATURE

"A 1955 NEW LOOK AT MTM"

By Robert J. Levin
Production Engineer, United Mills Corporation
Mt. Gilead, N. C.

As I remember it, it was just about five years ago that Needle Trade Magazines first published articles on MTM . . . Methods-Time-Measurement . . . . "the new engineering procedure that *was supposed to make* it possible to set standards and improve methods without the use of a stop watch."

As an early skeptic of the procedure, and a strong one, I can take back those words "was supposed to." MTM works. And it works wherever there are sewing operations—shirts, suits, ladies' slips, pants, bras, and shoes too.

What do I mean by "works?" Just this. MTM saves TIME. It makes MONEY. Not only for my company, United Mills, but for the great number of other users who have cooperated with me in putting this story together. They are Enro Shirt Company, Louisville, Kentucky; Handmacher-Vogel, Glasgow, Kentucky; Connellsville Sportswear Company, Connellsville, Pennsylvania; Society Lingerie Company, Michigan City, Indiana; and, the Ohio-Indiana-Michigan Garment Manufacturers Association. In addition, I will mention a few figures I have taken from Deltox Rug Company, Oshkosh, Wisconsin, and Pekay Leather Products, Inc., of Knoxville, Tennessee; these latter two just to back up a few of my statements.

It is my understanding that Cluett-Peabody and Singer's work in MTM has already been fully reported, as well as work in the shoe industry, such as General Shoe in Knoxville, Tennessee.

My own company, as were most of those who appear in this story, was trained in MTM by management consultants, who had extensive experience in application of MTM to the apparel manufacturing and needle trades.

After all of this, what have been the experiences with MTM in the needle trades?

UNITED MILLS CORPORATION
Mt. Gilead, N. C.

At United Mills we have lowered our costs, across-the-board, by 20%. This is not a one time savings on a new line, but a real basic 20% savings on our sewing operations, present and future. When you consider we have 1600 employees, you can see what this means. Also we have been able to increase our production quotas on all sewing operations by about the same amount; it varies. Sometimes we manage increases of nearly 30%, sometimes it drops below 20%. But these figures are enough to make a person stand up and take notice.

Here's something else, we set all rates before garments go into actual work—and "motion the style out" so that only those handling times are allowed which tie in with our quality requirements.

We have shortened operator training time by 25% —in round figures. This is a cost reduction item of some importance. But with greater work in this area, we expect to attain results of twice this figure.

We are constantly expanding our standard data file, and find that on basic sewing operations, MTM, of course, sets the times in a small fraction of what it might take with time study. We have found MTM much more consistent and accurate. Most important —we get better labor acceptance of MTM times than we ever did through the stop watch. Most of this is due to the fact that operators can "see" and "follow" the MTM values. This, by the way, is not a piece to discredit the stop watch. We still use it. But much less frequently than we did before. The principal reason for this is because our whole plant—my own staff, the floor ladies, and the operators themselves —are sold on MTM, and understand it. At least, in the case of operators, they are able to follow what we are doing with MTM much better than they were able to do with the stopwatch. This is easy to understand since MTM actually spells out in time values each move, reach, grasp, etc.—while the stop watch normally does not do this, but rather a time value is recorded for the entire motion pattern. The only trouble here, though, is that MTM is deceptively easy to understand—and in the hands of an *inexperienced* user or observer, the best results are not always obtained.

The best advice I can give to anyone interested in applying MTM is *to make certain that whoever uses it is thoroughly trained.* And this is just as important for the graduate industrial engineer with years of experience, as it is for the novice. Industrial engineering experience, no matter how broad, does not mean that the man will be able to do good MTM work merely by reading a book and then attempting to apply it.

The real reason that MTM has been such a wonderfully profitable tool for our company is because

of the extensive training we went through before trying to apply it.

Certainly there is probably much to be said for the three-week classroom training programs held by consultants experienced in the trades. 105 hours of actual classroom training is the minimum allowed by the MTM Association for Standards and Research —a group of college professors, companies, industrial management consultants, interested in furthering MTM development. Some of the companies on which I am going to report have had no more MTM training than these three weeks—yet they have made savings above and beyond what I might have believed. So, it has to be good training—or perhaps MTM is just so good that it can't help but work.

What we did was to bring a staff engineer from a consultant firm right into the plant—and he proceeded to do "on the job" MTM work, as well as train us.

Us? Yes, I took the training, on the job and in "classroom," and so did eleven of my management trainees working on the floor, our cost accountant, office clerk, our four plant managers, four mechanics, two pattern makers, and two office girls. And, in addition, we held regular MTM appreciation courses at night for all 24 of our "foreladies" or "floorladies." Incidentally, we call the latter "appreciation training." Today, these floorladies are almost MTM experts.

Why did we train all of these different people? Because all would have to understand something about MTM in the general course of their work. Eighteen months later we brought consultants back to train additional people. We were too busy to do it ourselves.

Let me put it this way. The more money spent on MTM—the more returns we get from it. Surely, it would have been simpler just to have myself trained and let it go at that. I would still have made savings in the five figure bracket, probably. But the way we did it—we're up into the healthy six figure bracket in savings—at a four figure cost. Is that good? We think so.

There are always foibles. One of ours is in design. In about three to five minutes, we can tell designers just what their changes on garments will cost—much to their dismay, now and then. Using MTM, we explain, and sometimes demonstrate, what the cost of their design will be . . . and we have thrown out many a beautiful and intricately designed garment, just by *stating and proving* costs. At first, our designers resented this somewhat—but now they appreciate it.

To sum all this up: Our floorladies have a really vivid realization of *time*.

MTM insures that only one method be used and that any deviation is loss to the operator and as a result—to the company. We have charts which show the operators how much money they lose daily by inserting an extra move, stop, etc. We intend to take the poorer operators back into the training section and work with them until they pick up speed on those elements which are below standard.

MTM has improved the morale of our working force considerably in that once and for all an operator knows that—if we add any extra motion—she will be compensated for it, no matter how small. Conversely, they also know that if the company dreams up a better method, they will have to do more dozens. Under the old system it was just guess and pray and get "loused up."

When operators claim that they can't make standard, we actually take the MTM studies out on the floor and go over each movement, step by step, with them and have them point out where we haven't covered the method completely. This sells them on the fairness of the plan and standard is usually reached very shortly afterwards.

We are positive now that our standards can be met and we keep after the girls until they reach that goal. With time study, we were talked out of many standards because we were not sure ourselves if they were too tight.

Now, we have faith in our prices and can convert to standard costing without too much worry. Each factory will have an "effectiveness rating" each week which compares standards against actual time spent. This alone is bringing up the level of efficiency in all our plants.

Finally, two points: We are working on a system through MTM which will not only tell us *exactly* how long the training period will be for *any* operation, but will also tell us in which job grade the classification falls depending on the complexity of handling elements.

MTM has also brought us "insurance" that we are right in expecting the quality we do. If we want a perfect corner on a seam tolerance of 1/32"—we must give the correct number of alignments and hesitations, etc. And if we do, then we take the stand that every garment must be perfect. Most important —our operators like this idea. It gives them a sense of pride and accomplishment.

Yes—I've been tooting the horn for MTM. It has made us money. The operator is happy, the floorlady is happy, the managers are happy, and top management, too, is happy. *What more can I ask?*

After this vote of confidence in MTM, let's hear from some other companies. Here is one of particular interest to most of the readers of this publication:

CONNELLSVILLE SPORTSWEAR COMPANY
Connellsville, Pa.
(One of the larger makers of men's and boys' trousers and slacks)

Allan B. Barry, production and quality supervisor, was trained in MTM by MTM consultants. I did not talk with him personally, but he will stand behind my words. A questionnaire was sent to him and a plant visitation was made by an MTM engineer. Here are the results: In the first place, his father, M. M. Barry, General Manager, insisted upon being trained by his son in the technique.

"By some strange miracle, MTM seems designed especially for sewing operations—though I understand the data was compiled from drill presses. In my thirty years in this industry, nothing has revolutionized it so thoroughly as MTM." M. M. Barry speaking.

There are big savings in sight, say both Barrys. And they have opportunity for it with more than 600 operators. How? What savings?

Connellsville Sportswear has not touched the old standards. But on everything new, MTM is used. And MTM-set standards prove to be more equitable than those set by conventional means.

In methods improvement—developing a side pocket corden, three operators used different methods. One operator was 12% more efficient than the others. After analysis by MTM it was improved further by another 25%. And all three operators soon achieved this goal.

Mr. Barry believes that the use of MTM "proves" management is sincere in trying to set a fair rate, because his operators, like our own, can understand its principles.

Both Barrys, senior and his son, claim (1) greater consistency with MTM, (2) faster setting of rates, and (3) better acceptance by the operators.

In cost estimating, the Barrys say MTM is several hundred percent faster than time study—and *more accurate.*

Summing it up, Allan Barry, production supervisor, has this to say: "We feel that we have found a method to set rates on new operations quickly and easily, as well as equitably. *It is easy to sell labor and unions on the reliability of this method.*"

Hugh Miller, Secretary-Treasurer of the Ohio-Indiana-Michigan Garment Manufacturers' Association has this to say: "MTM is an important tool to the various manufacturers in our organization in helping train operators and in setting rates." This Association actually sponsored an MTM training program conducted by consultants in the Midwest. Mr. Miller's own company—the Jay Garment Co., Portland, Indiana —uses MTM, but not extensively as yet. They use MTM mainly as a guide in setting rates—and they feel MTM rates are more equitable. Also, they plan extensive MTM usage in helping train new operators.

ENRO SHIRT CO., Louisville, Ky. General Superintendent and plant manager, William R. Hoffmann, says that, "If we were opening a new plant where no standards or rates were in effect, we would use MTM exclusively." The situation there isn't like that, however. Enro has standards going back for several years. But Mr. Hoffmann, Bill Jolly, his assistant, Lawrence Eckman, Manager of the Madisonville plant, and Verena Richardson, stitching supervisor, have all been trained in MTM.

"We are much more motion-conscious, which means *cost reduction conscious,* as a result of MTM," says Bill Jolly. He also points out that Enro has used MTM more for reduction of indirect work—not sewing. So far Enro's savings took place mainly in packing and shipping—a costly item.

Before MTM was introduced, the Packaging Department was not on standards because time study had proven too slow to do the job without excessive costs. "But MTM did the job quickly," says Bill Jolly, "95% of our packaging work is now on MTM standards."

Enro has re-designed many of the work stations in their packaging department as a result of MTM. One has to do with slipping cardboard sheets over the top of the shirts just before the shirt box was closed. Formerly, the wrapper had a stack of cardboard sheets on her right side. She grasped the sheet and then moved it to the box. Today, due to re-design of the layout, she merely reaches at shoulder length and slides the cardboard into the box. This increased performance by nearly 50%. There are several such accomplishments at Enro—but this is illustrative of how MTM works in indirect work there.

They are also in the midst of making a layout, and setting standards for their shirt warehouse—and they expect savings to be very high. (MTM has been used successfully in many warehouses in other industries with savings up to 39% of present costs. There is no reason to believe that similar results will not be forthcoming here.*

* Logan Company, Louisville, Kentucky; General Shoe Corporation, Nashville, Tennessee.

Summing up Enro's experience with MTM, Bill Jolly says: "MTM is a whole new trend in thinking as far as cost reduction is concerned at Enro. We expect to keep on using it, and making our own refinements for years to come."

SOCIETY LINGERIE COMPANY, Michigan City, Indiana. Here is a company of a total of about 65 employees. Howard Lickerman, their production engineer, is perhaps the most enthusiastic MTM-er around.

"We have saved as much as 40% on seaming operations through MTM and we have achieved better utilization of equipment with a subsequent reduction of trained personnel formerly needed."

He goes on to point out countless other savings—as for instance, the savings accrued from eliminating the use of a small label and incorporating it into another label, making one larger label. "There was a question on this," he states, "until we realized that it would save up to 40% of previous costs. We now make one label do in this instance."

Howard is a good stop watch man. When he found MTM did, in minutes, what might take hours by the stop watch—*in estimating*—he made the switch and now uses MTM for all estimates.

In stitching lace on a garment, the standard moved from 50 dozen per day to 90 dozen per day—with few operator complaints.

One of the big things done at Society Lingerie was a shift in emphasis on "ideas." Where formerly the operator got her own material and placed it where she wanted it—now unskilled help is used to bring the material to the operator—and the operator never leaves her station at all, except for personal needs . . . cigarettes, a drink of water, and normal rest periods.

At first, Howard says, the older operators resented the changes—"all operators were taught a new motion pattern as a result of MTM, but most of them like it today. Of course, there are a few old-timers who still don't like the whole idea, but when they see a newcomer doing better than themselves, they usually come around."

Society Lingerie even has inspection on standards, making use of the MTM standards for eye focus time. It gives them better inspection at lower costs, according to Howard Lickerman.

Here is an unusual wrinkle: Society Lingerie needed a taping machine. They called in several manufacturers—and then through MTM set up a motion pattern for each. In this way, they were able to select the best taping machine from a cost-of-use standpoint. Incidentally, Howard Lickerman feels that the manufacturers of automatic bookkeeping equipment are missing a bet in not applying MTM to machine design, too.

They have over 5000 standards at Society, making a tremendous variety of slips, nightgowns, pajamas, petticoats, bed jackets, and so on. These are all coming under MTM now.

To sum it up at Society Lingerie, here is the gist of Howard Lickerman's analysis:

"We are manufacturers of a number of products in small lots, and have found it almost impossible in the past to realize a savings which can be obtained through mass production methods. It has been extremely difficult to determine correct incentive rates due to the small lots being processed. We have encountered inconsistencies in rates quite frequently due to the fact that the operators on successive days work on successive types and styles of garments. They may have greater or lesser ability working with different styles, which is extremely difficult for an observer to determine.

"Through MTM we have at last achieved a consistent and accurate set of standards in almost every department. Departments such as Cutting, Spreading, Marking which heretofore have resisted time study and where time study means tremendous cost in time and personnel, are currently being studied by means of MTM. The savings that we expect to receive will place our products among the most competitive in the country making a similar price and type of merchandise. This would not have been possible through conventional time study, for the time necessary would have been exorbitant. I feel that MTM for a small organization manufacturing a number of products, is an unusually efficient tool."

HANDMACHER-VOGEL, Glasgow, Kentucky. As one of the largest makers of women's suits, Handmacher-Vogel has long been an MTM user. George Scalise, industrial engineer of the plant at Glasgow, Kentucky, wrote an article for Apparel Manufacturer in the May 1951 issue, describing his MTM work in detail. What he didn't say then was:

"We have realized a 50% reduction in training time of newcomers to the sewing business. And surprisingly enough, we save 20% training time on experienced operators placed on new jobs."

Scalise is a great believer in using the simplified MTM data for tailors and foreladies, having had excellent results in improving both quality and performance in their work. "What I said in 1951 still goes," says Scalise.

In addition, George Scalise points out that MTM makes it "easy" to visualize production bottlenecks of all kinds—and that MTM has made it possible—*through methods improvement* . . . to increase production and earnings everywhere it has been applied.

"MTM," he points out, "is bringing the whole industrial engineering profession nearer to being a *science*."

Wilson Brothers, Oshkosh B'gosh, Ely & Walker, and General Shoe in the stitching rooms are just starting with MTM, though Wilson Brothers have been using it very successfully for cost estimating.

Of course, Singer and Blue Bell overall are among MTM's oldest users—the latter having written on MTM in this publication. Successful MTM usage has also been reported by Union Special Machine Company, Kickernick, Woodbury Manufacturing Company and others.

At the beginning of this article, I said that "MTM could be applied wherever sewing had to be done." R. E. Zernzach of Deltox Rug Company, Oshkosh, Wisconsin, admits to a 30% savings on short cycle operations through MTM, and he believes MTM is the best methods improvement tool he has ever encountered.

Paul T. Brown, Pekay Leather Products Inc., Knoxville, Tenn., says his savings are about 20% and production is up about 20%, too, with even fewer operators. He has also applied MTM to saving walking time, improving work place layout, and has redesigned his shipping department.

Finally, all I can add is that with MTM, you pay your money and take your choice—of where you want to apply it. Wherever you do—it will save you money. Lots of it.

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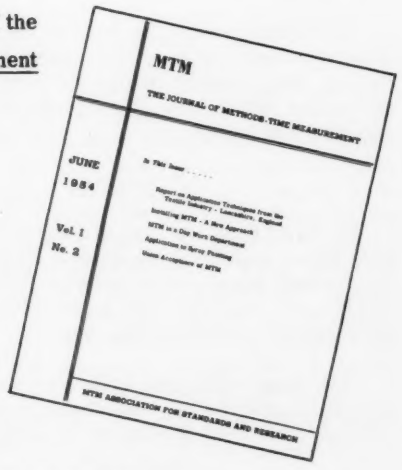

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TECHNICAL

STANDARD DATA FOR EYE TIME

By Lawrence L. Lavigueur

This article is presented as an approach to applying eye time for analysis purposes. Because of the technical nature of the material, it has been placed in the Technical Section of the "Journal."

Methods time measurement has standard allowances for various motions, among these are eye focus and eye travel.

Eye focus is the focusing of eyes onto an object as to distance.

Eye travel is movement of eyes across a plane from one point to another.

A problem arises when an engineer tries to establish rates on inspection of small parts. These parts are anywhere from 4" x 2" surface size to parts 1/8" x 1/8" x 1/8" or even smaller. This work is highly repetitive, therefore, the operators are thoroughly experienced and perform their duties with utmost speed, skill, and least effort. They must reject work for light marks of minute size, perhaps as small as .003" diameter image. However, quality control has set standards that inspectors must follow. Therefore, decisions must be made as to pass or reject part. These marks or questionable images do not appear throughout the parts, therefore, three separate allowances must be used for the purpose of determining time to inspect a given part.

First element is saccadic movement which means that the eye sometimes moves by jumps between fixations.

Second element is fixation, which is a pause to direct eyes on a given point to image on the fovea.

The third element is decision time which is the time necessary to perceive, comprehend, and make certain associations before proceeding to the next movement which may be to pass or reject part for questionable image.

Procedures

In performing the task of inspection, many separate basic motions take place. These motions, not necessarily in sequence, would include reach, grasp, move, turn, regrasp, and many others to which we have predetermined allowances.

The other elements to be considered during the task of inspection are eye focus, eye fixation, and decision time and movement of eyes between fixations. These elements require predetermined allowances or some formula or means of establishing an allowance that is practical and adequate. The following paragraphs will tell how and why certain assigned allowances were determined.

Eye focus has a basic allowance assigned to it of 7.3 T.M.U. This time is considered as being the time necessary to adjust the eye to a set distance.

Eye fixation and decision time as referred to in this experiment is a pause whereby the operator must examine closely an image and make certain associations and a decision.

The area of fixation varies greatly depending on the keenness with which the image must be perceived, the person, their training and ability. Some people can see an image subtending a 1 minute angle at a distance of 8" to 10" from the eyes. However, in the task in question usually the image is of greater size, therefore, the problem of image size is not a major factor.

There are many variables affecting eye fixations and the task of inspection in general, some of these are image size, contrast between object and background, proper lighting, time allowed, operator's training and ability. I am assuming that these operators are properly trained and experienced and are working under average conditions at average speed.

Many experiments have been made in experimental psychology to determine time of fixation pause. Some of these as stated in:

Experimental Psychology
by Robert S. Woodsworth

These results are for complex reactions and are believed comparable to reactions necessary for inspection. The operator must associate images as being passable or not and direct other members of the body in making the next movement.

The first experiment was the distinguishing between lines of different lengths, same width. The average time taken to give a hand signal to a visual stimulus, when two lines, one 10. m/m and another 10.5 m/m in length were examined, was found to be 345 ms.

Another experiment given to 113 college students, 40 reactions recorded by each student, gave the following average results. The experiment and results follow:

The student sat at a table facing two square frames containing 16 bulbs each. One to five bulbs were lit in one frame and one fewer in the other frame. The subject had to give hand signals with the hand on the side of the larger number of lit bulbs.

Stimuli to be Discriminated	Ave. Reaction Time
1 and 0 lights	290 ms.
2 and 1 lights	475 ms.
3 and 2 lights	566 ms.
3 and 4 lights	656 ms.
4 and 5 lights	741 ms.

Another experiment stated in Woodsworth Experimental Psychology, Fifth Edition, Page 355, par. 1 relating to reading experiments states that reading one short word or one letter per fixation takes approximately 2/5 seconds or 400 ms.

From these results the average time necessary for eye fixations was derived as being about 360 ms. The other part of inspection is covered by saccadic movement.

The eyes sometimes move by jumps separated by fixation pauses, these jumps are referred to as saccadic movement. The time for saccadic movements between fixations varies approximately as to distance between pauses.

During saccadic movement, images may be seen in the peripheral vision with enough distinction to ascertain whether or not a fixation pause is necessary.

Return sweep is the movement of the eyes from one plane or surface, to another. This movement is covered by the formula and chart now used in Methods Time Measurement called eye travel time. This motion is seldom limiting as stated and proven by MTM.

The last elements to be considered are the hand motions after the eyes and mind have decided onto action being taken. Here MTM has a set of standard data to apply covering any motions that may take place. For example, if a piece has a rejectionable characteristic and the operator decides the part must be rejected due to quality standards and requirements not having been met, then the part must be put into a box or in a specific place to be forwarded to its proper destination, either salvage or scrap.

How to Compute

I. Determine whether an eye focus is needed.
   Note: If objects remain at approximately the same distance from the eyes, then the eye focus allowance should be carefully studied.

II. Designate number of fixation pauses necessary.
   A. The area of fixation varies greatly depending on the operator, but for our purpose for maximum visual accuity, the area is thought to be 5' subtended angle. This acute vision is necessary to make decisions. However, the average person will see any other foreign images within an area of about 3^0 with enough perception to designate whether or not another eye fixation pause is necessary.
   B. These areas requiring fixations may be affected by:
      1. Any change in contour shape, color, or color pattern and schematic design arrangement.
      2. Points where operations stop or start.
      3. Where two parts are assembled together or where part has been removed.
      4. Areas that, through quality requirements, have proven troublesome.
      5. Percentage of rejects in a lot.
         a. Each reject may require an added fixation pause depending on reason for rejection. If part is rejected for marks, deformities or any type of rejectionable image not directly connected to any previous operation, then a fixation pause is definitely required, as no allowance has been previously allowed because as stated before, allowances can only be assigned to repetitive and permanent conditions and not to variables such as this case. Conversely, if a part is rejected for defects at an area considered as an area normally requiring a fixation pause, and having been figured as such, then it may be clearly understood that by giving another eye fixation pause for this area, would be doubling the allowance given to rejects for this case.
         b. Another allowance that must be accounted for are the parts having questionable images. These images are border line cases where the operator must make judgment, but the part is not rejected as quality standards permit these parts to be accepted. From studies and incentive rates set using this information, I have had satisfactory results using 50% of the average number of rejects per lot as the number of fixation pauses necessary for questionable but not rejectionable images.

c. A survey should be made of many lots of the work for which the standard is being sought, to determine the average number of rejects per lot. This may be taken from inspection records, which also may help in determining areas requiring added fixation pauses. This rejection percentage should also appear on the analysis, as it is important information for both quality control and standards department data.

d. For use in manufacturing, for estimating or setting incentive rates, each case should be studied carefully before applying any basic allowances. However, properly trained men will find rates and estimates set by use of a set basic allowance will give fair, adequate, consistent studies and rates. If the same basic allowances are used on the same type of work, the rates will be consistent. Also the information required to set these standards gives the standards department very close control of rates and any change in rejection allowance would be readily evident and the rate should be adjusted accordingly.

C. The allowance of 10 T.M.U.'s that I have allowed in my experimental studies was taken from the various experiments stated earlier in this report. From the reading experiment, results of 400 ms. was found to be average time. From experiments on lights lit on panels for determining between 1-0 lights and give hand signal was 290 ms. and 2-1 lights time 475 ms. and time taken to distinguish between lines 10 m/m and 10.5 m/m and give hand signal to a visual stimulus was found to 345 ms. By conversion from milliseconds to T.M.U.'s, 10 T.M.U.'s equal 358 ms. Hence for every eye fixation necessary, the allowance of 10 T.M.U.'s is to be allowed.

III. Determine areas to be covered by saccadic movements. The surfaces between fixation pauses are covered by this movement. The following chart of approximate times may be found helpful:

Duration of saccadic eye movement
Experimental Psychology
By Robert S. Woodsworth
Extrapolated from Dodge & Cline 1901
Chapter XXIII—P 584

Extent of Movement			Duration of Movement
1° to 3° or up to	3/5" at	12" from eye	20 ms.
4°	4/5"	12"	26 ms.
5°	1"	12"	29 ms.
6°	1 1/5"	12"	31 ms.
7°	1 2/5"	12"	33 ms.
8°	1 3/5"	12"	35 ms.
9°	1 4/5"	12"	37 ms.
10°	2"	12"	39'ms.
15°	3"	12"	48 ms.
20°	4"	12"	55 ms.
30°	6"	12"	80 ms.
40°	8"	12"	100 ms.

To apply saccadic movement allowance first determine areas to be covered by eye fixations or accomodations. Allowing 3° or about $\frac{1}{2}$" diameter area of surface for each fixation, then the distance between fixations should be measured and the proper allowance for each distance added to the basic allowance for all fixations, eye focus, reject and questionable part allowances and all other limiting motions. Some variables that may affect saccadic movement are:

1. If part is smaller than 3° or 1/2" in diameter, then no saccadic movement should be allowed.
2. If large part is inspected such as 10" x 12" surface, then area between fixations figures in degrees should be added to fixation time.
3. Care must be taken to be certain, eye time, either focus or fixation, are limiting motions.

Here are a few examples of experimental studies I have made with the results.

Inspect Bar & Brace Assembly. Rate .23/100 singles.

This is a U shaped bar made of rectangular stock .045" x .070" x 2" to 3" long. Bar is bent U shape and a brace is soldered to the back crest section. The two legs of the bar are soldered on the eyes as well as the two legs of the brace. However, this job is to inspect the bar and brace assembly before soldering to the eyes. The assembly is about 1 1/4" x 1" x .045.

The operation is set up as follows:

Pick up assembly one at a time, inspect front for marks, brace off center, poor material, poor shape bar, poor engraving. Aside bar to third finger of right hand. Repeat for three assemblies. Inspect three at a time on finger for marks on edge of legs, poor shape, burrs on trimmed legs, poor shape chest, poor soldering. Remove from finger, one at a time, and inspect backs for marks or flat brace. Aside assembly to pan. These assemblies have a 25% rejection allowance.

10.1	R6C	Reach to piece on bench
1.7	G1A	Grasp piece and
11.3	M10A	move to work area about 12" from eyes
7.3	E. Focus	Focus eyes on piece to adapt for distance
60.0	6 (E. Fixation)	To inspect 2 legs for burrs at trimmed foot, poor shape, the breakdown is as follows:

		1 E. Fix. for change due to preceeding operation of Trimming legs x 2 legs
		1 E. Fix. for shape & angle of bend also done at a preceeding operation x 2 legs
		1 E. Fix. for ends of brace, inspecting for marks, shape & burrs x 2 legs
2.0	5 (1/2" S.M.)	Saccadic movement. Allowance between Fixations
3.6	M2A	Move inspected assembly to rack on finger
5.6	PISE	Position on finger
1.7	RL1	Allow above time for each assembly
103.3	X1	Repeat for 3 assemblies.
3.6	M2A	Move 3 assemblies on finger to work area
1.7	G1A	Grasp to hold for inspection.
60.0	6 (E. Fixation)	1 for each of 2 characteristics that is shape and marks, and trimming of each leg of 3 assemblies
9.4	T 180°S	Turn assemblies to inspect other legs
60.0	6 (E. Fixation)	Same as other leg
5.4	T 90°S	Turn to inspect crest of top section
30.0	3 (E. Fixation)	1 for each assembly, inspecting for
170.1	+ 3	soldering and shape simultaneously
56.7		Total Time divided by 3 assemblies.
4.2	M2B	Remove one assembly from finger,
5.6	G2	regrasp to turn assembly to inspect back
7.3	E. Focus	To adapt eyes to distance to position assembly
30.0	3 (E. Fixation)	One for each leg and one for crest, inspecting for marks and flat brace
1.2	3 (1/2 Sec.M.)	Saccadic movement to cover areas between fixations
4.2	M2B	Move assembly to aside in pile on bench
1.7	RL1	to drop in pile
2.5	Reject	Rejection allowance of 10. T.M.U. necessary for each reject therefore 25% x 10. T.M.U.'s
		Added 50% of rejection percentage needed for questionable but not rejectionable parts
1.25		Percentage is 50% x 25% or 12½% therefore,
57.95	X1	12½% x 10. T.M.U.
217.95		
.0006		
.130680	Std. min. per pc.	

Rate set by use of this standard time would be .223/100 sing. From past experience on old standard, price set at .23 a hundred singles, the average earning by several operators over the past two years was 20-30% above base rate.

Another example, is inspection of very small parts. In this case, part is smaller than 1/4" by 1/4" x 1/16", this is a bent and looped piece of wire having a hole in one flattened end.

We have a rate which has proven adequate for this job over many years, with average earnings of about 20-30% above base rate.

The MTM breakdown follows:

Description of the operation is that an operator moves one part from a pile using one finger of right hand to flick part to work area which is a dark cloth on bench to provide contrast, as these are metal parts either gold or silver colored. After part is separated from its pile, it is inspected on one surface, then turned over by use of finger and inspected on other side, then left hand, after inspection, moves part to accepted pile or to rejected pile. Part is inspected for burrs at one end, and at pierced hole, in other end, and looping and bending shapes; and other defects such as marks, etc. are covered during eye fixation on each end.

MTM Analysis

7.3	R3C	Move part to work area
.0	G5	Contact grasp
5.7	M3B	Move part by flicking
.0	RL2	Contact release
10.0	E. Fixation	Inspect one end for burr, scan surface for marks
2.1	R1B	Turn over piece to inspect 2nd end & surface
	G5	
3.4	2 (M1B)	
.0	RL2	
10.0	E. Fixation	Inspect 2nd end for burrs and loop and surface marks. Aside piece left hand while right hand reaches for next.
1.5		15% Rejects therefore 15% x 10.0 = 1.5
.75		50% x 15% x 10.0 = 0.75 Questionable Allowance
40.75		

40.75 T.M.U.'s

.024 Elemental Time

.0412/100 Sing. Using 10% fatigue, Rate would be: .0412/100

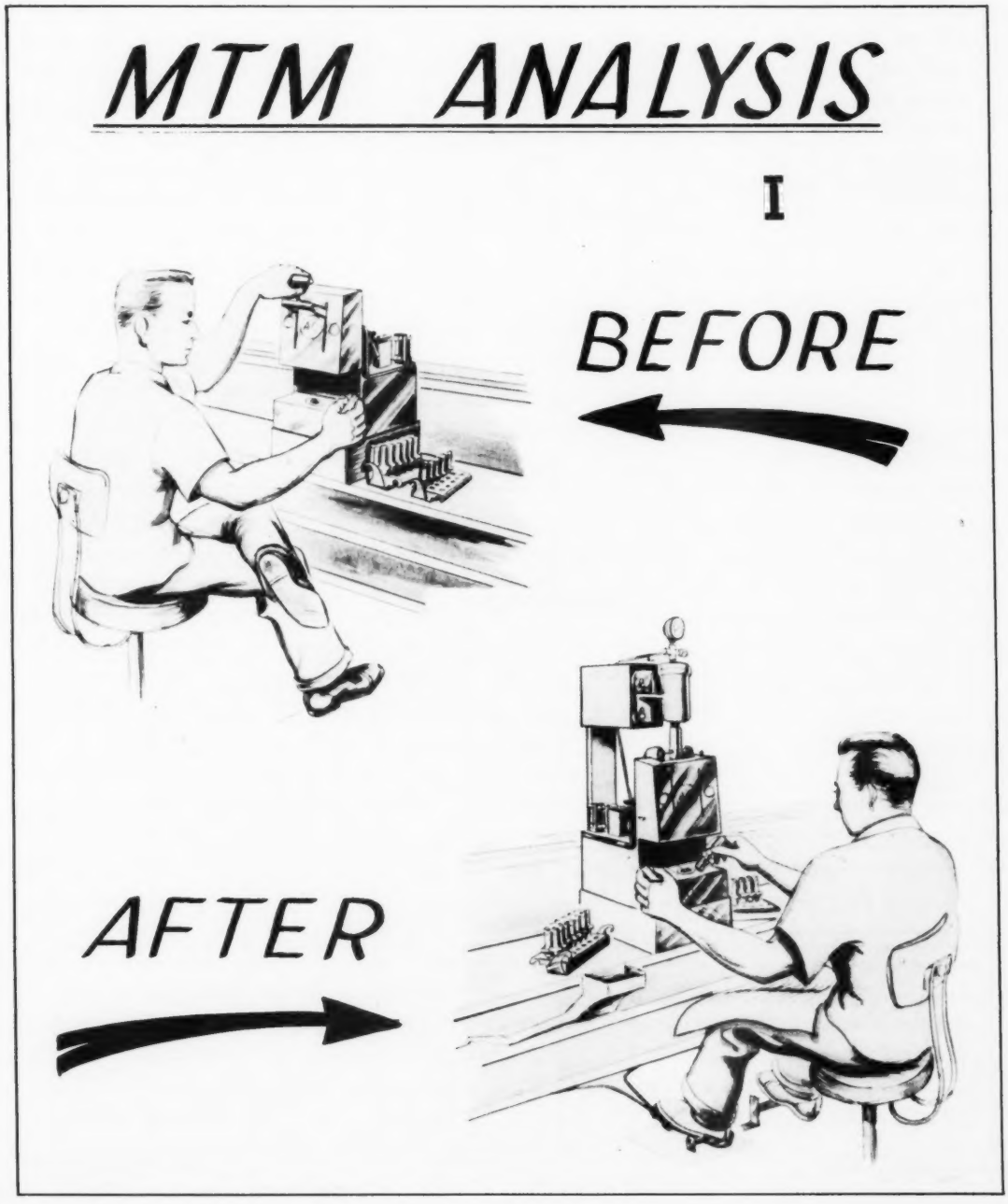
Present rate is .046/100 singles and earnings are about 30% above base rate which is rather high according to MTM. Also in setting of this rate a few years ago, the fatigue allowance used was 15% which would account for the difference in price.

In conclusion, rates set by use of this standard data by a properly trained analyst would give consistent rates or estimates, because the same amount of time would be allowed in all similar cases. However, as stated before, an industrial relation allowance may have to be made to maintain earnings to conform to present wage scales in any particular industry. The given allowances will give the analyst a tool to help him in establishing piece work rates without having to level watch recordings which is the most troublesome factor in setting or administering piece work rates to employees.

APPLICATION

This is the second in a series of "Before and After" studies submitted by Mr. Clinton Brauer of Kelly Air Force Base, San Antonio, Texas.

The MTM Analyses define the change in methods that occur in using new equipment to do the job more efficiently. From another angle, proper design of new equipment using MTM and visualization will result in better methods and subsequent savings in time.



PRESENT METHOD

OPERATION SUMMARY

PART Spark Plug No. 381 DATE 1 Jun 54 STUDY No. 118

OPERATION Bomb Test ANALYST Brauer SHEET No. 1 OF 3 SHEETS

No.	ELEMENT DESCRIPTION	ANALYSIS CHART REF.	ELEMENT TIME TMU	CONVERSION FACTOR .0006 LEVELED TIME	% ALLOWANCE	ELEMENT TIME ALLOWED	OCCURRENCES PER PIECE OR CYCLE	TOTAL TIME ALLOWED
1	Get and Place Plug		56.3	.034	15	.039	1	.039
2	Test Plug		28.3	.017	15	.020	1	.020
3.	Remove Plug From Tester		39.3	.024	15	.028	1	.028
4	Reject Plug Aside		56.4	.034	15	.039	1/20	.0195
5	Place Tray on Conveyor		28.7	.017	15	.020	1/21	.0009
6	Get Tray From Conveyor		35.4	.021	15	.024	1/21	.0011
		PRESENT METHOD						

METHODS ENGINEERING COUNCIL FORM NO. 199

TOTAL TIME ALLOWED PER Plug .1085

PRESENT METHOD

METHODS ANALYSIS CHART

REFERENCE No. _____

PART Spark Plug No. 281 DATE 1 Jun 54 STUDY No. 118

OPERATION Bomb Test ANALYST Brauer SHEET No. 2 OF 3 SHEETS

DESCRIPTION — LEFT HAND	No.	L H	TMU	R H	No.	DESCRIPTION — RIGHT HAND
Element No. 1 Get and Place Plug						
Reach for Plug		R12B	12.9			
Grasp Plug		G1A	2.0			
Move Plug To Tester		M12C	15.2			
Regrasp Plug		~~G2~~				
Plug Into Tester		P2SE	16.2			
Release Plug		RL1	2.0			
Hand Clear		R6E	8.0			
			56.3			
Element No. 2 Test Plug						
			10.5	M9A		Pull Test Lever
			7.3	EF		Check Spark Flasher
			10.5	M9A		Test Lever Up
			28.3			
Element No. 3 Remove Plug From Tester						
Reach For Plug		R6A	7.0			
Grasp Plug		G1A	2.0			
Disengage		D1E	4.0			
Move Plug To Rack		M16C	18.7			
Regrasp Plug		~~G2~~				
Plug into Rack		P1SE	5.6			
Release Plug		RL1	2.0			
Reach For Next Plug						Next Cycle
			39.3			
Element No. 4 Reject Plug Aside						
			2.0	RL1		Release Test Lever
			9.6	R12A		Reach For Plug
			2.0	G1A		Grasp Plug

No.	ELEMENT DESCRIPTION	ELEMENT TIME TMU	CONVERSION FACTOR .0006 LEVELED TIME	% ALLOWANCE	ELEMENT TIME ALLOWED	OCCURRENCES PER PIECE OR CYCLE	TOTAL TIME ALLOWED
1	Get & Place Plug	56.3	.034	15	.039	1	.039
2	Test Plug	28.3	.017	15	.020	1	.020
3.	Remove Plug From Tester	39.3	.024	15	.028	1	.028
						TOTAL	.087

METHODS ENGINEERING COUNCIL FORM NO. 198

PRESENT METHOD

DWG. NO.

PART DESCRIPTION	MATERIAL
Spark Plug	

OPERATION: BomB Test

OPER. NO. 20

LOCATION: Spark Plug Unit

OPERATOR

MAN / WOMAN — NAME: T. W. James — NO. 86591

EQUIPMENT

A.C. Aircraft Spark Plug Bomb Tester

SPECIAL TOOLS

None

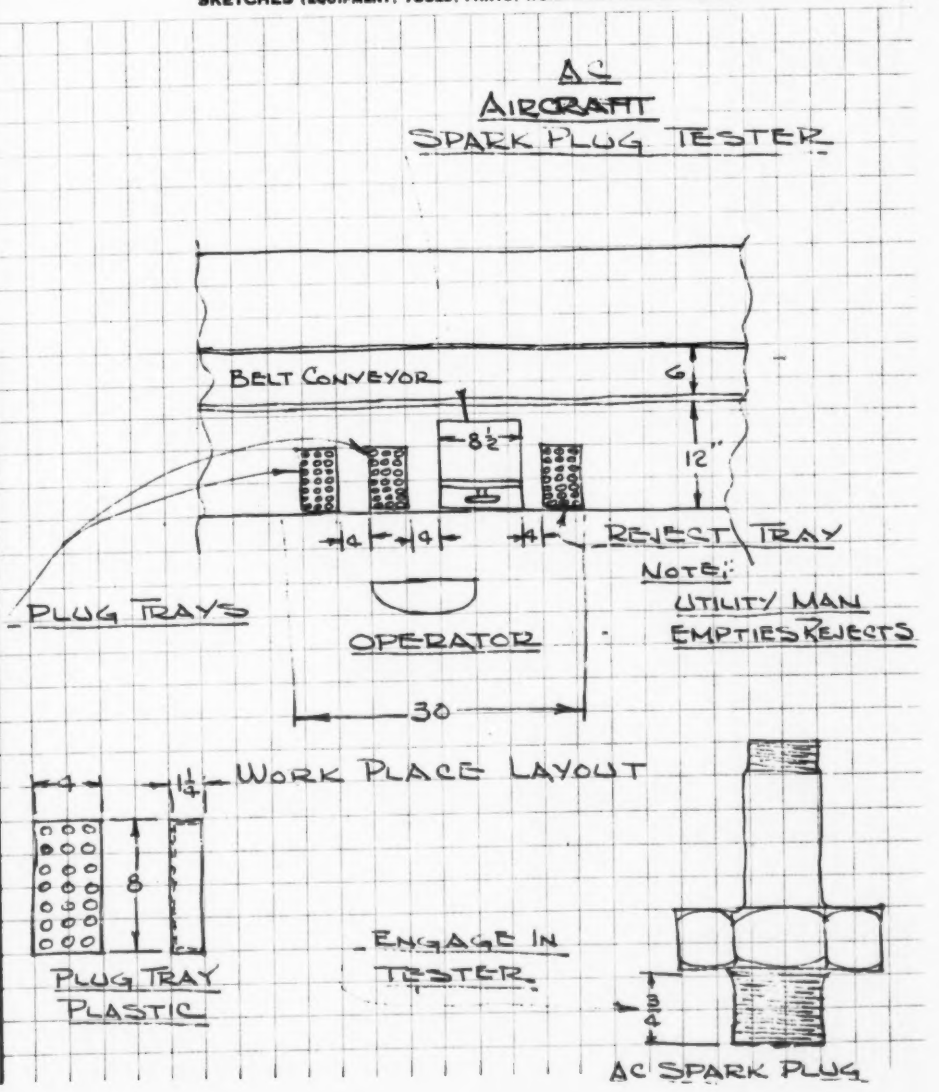
CONDITIONS: Good

QUALITY REQUIREMENTS

STUDIED BY

APPROVED BY

SKETCHES (EQUIPMENT, TOOLS, PARTS, WORK PLACE LAYOUT, ETC.)



PRESENT METHOD

METHODS ANALYSIS CHART

REFERENCE No. _____

PART Spark Plug No. 281 DATE 1 Jun 54 STUDY No. 118

OPERATION BombB ANALYST Brauer SHEET No. 3 OF 3 SHEETS

DESCRIPTION — LEFT HAND	No.	LH	TMU	RH	No.	DESCRIPTION — RIGHT HAND
Element No. 4 Con't						
			4.0	D1E		Disengage Plug
			16.9	M14C		Move to Reject Rack
			~~16.9~~	~~A2~~		Regrasp Plug
			5.6	P1SE		Position To Rack
			2.0	RL1		Release Plug
			12.3	R18A		Reach for Test Handle
			2.0	G1A		Grasp Handle
			56.4			
Element No. 5 Place Tray on Conveyor (lower Belt)						
Reach for Tray		R8B	10.1			
Grasp Tray		G1A	2.0			
Tray To Conveyor		M14B	14.6			
Release Tray		RL1	2.0			
			28.7			
Element No. 6 Get Tray From Conveyor (Top Belt)						
Reach for Tray		R14B	14.4			
Grasp Tray		G1A	2.0			
Tray To Bench Top		M18B	17.0			
Release Tray		RL1	2.0			
Reach For Plug		R12B				Start Next Cycle
			35.4			

No.	ELEMENT DESCRIPTION	ELEMENT TIME TMU	CONVERSION FACTOR .0006 LEVELED TIME	% ALLOWANCE	ELEMENT TIME ALLOWED	OCCURRENCES PER PIECE OR CYCLE	TOTAL TIME ALLOWED
	Element 1, 2, and 3						.087
4	Reject Plug Aside	56.4	.034	15	.039	1/20	.0195
5	Place Tray on Conveyor	28.7	.017	15	.020	1/21	.0009
6	Get Tray From Conveyor	35.4	.021	15	.024	1/21	.0011
						TOTAL	.1085

METHODS ENGINEERING COUNCIL FORM NO. 186

PROPOSED METHOD

OPERATION SUMMARY

PART Spark Plug No. 281 DATE 1 June 1954 STUDY No. 119

OPERATION Bomb Test ANALYST Braner SHEET No. 1 OF 3 SHEETS

No.	ELEMENT DESCRIPTION	ANALYSIS CHART REF.	ELEMENT TIME TMU	CONVERSION FACTOR .0006 LEVELED TIME	% ALLOWANCE	ELEMENT TIME ALLOWED	OCCURRENCES PER PIECE OR CYCLE	TOTAL TIME ALLOWED
1	Get & Place Plug		51.1	.031	15	.036	1/21	.0017
2	Test Plug		24.3	.015	15	.017	1	.017
3	Plug From & To Tester		64.5	.039	15	.045	1	.045
4	Reject Plug Aside		31.0	.002	15	.002	1/20	.0001
5	Place Tray On Conveyor		28.7	.017	15	.020	1/21	.0009
6	Get Tray From Conveyor		35.4	.021	15	.024	1/21	.0011
		PROPOSED METHOD						

METHODS ENGINEERING COUNCIL FORM NO. 199

TOTAL TIME ALLOWED PER plug .0658

PROPOSED METHOD

METHODS ANALYSIS CHART

REFERENCE No. _____

PART Spark Plug No. 281 DATE 1 June 1954 STUDY No. 119

OPERATION Bomb Test ANALYST Brauer SHEET No. 2 OF 3 SHEETS

DESCRIPTION — LEFT HAND	No.	LH	TMU	RH	No.	DESCRIPTION — RIGHT HAND
Element No. 1 Get & Place Plug						
Reach for first		R12B	12.9			
Grasp plug		G1A	2.0			
Move plug to tester		M12C	12.5			
Regrasp plug		~~G2~~				
Plug into tester		P2SE	16.2			
Release plug		RL1	2.0			
Hand clear		R2E	2.8			
			51.1			
Element No. 2 Test Plug						
			8.5	FM		Depress foot valve
			7.3	EF		Check spark flasher
			8l5	FM		Release foot valve
			24.3			
Element No. 3 Plug From & To Tester						
Reach for next plug		R10B	11.5	R12A		Reach for tested plug
Grasp plug		G1A	2.0	G1A		Grasp plug
			4.0	DIE		Plug from tester
Move towards tester		M10B	15.2	M12C		Move to rack
Regrasp plug		~~G2~~		~~G2~~		Regrasp plug
			5.6	P1SE		Plug into rack
Move to tester		M2C	5.2	RL1		Release plug
Into tester		P2SE	16.2			
Release plug		RL1	2.0			
Hand clear		R2E	2.8			
			64.5			
Element No. 4 Reject Plug Aside						
			9.6	R12A		Reach for plug
			2.0	G1A		Grasp plug

No.	ELEMENT DESCRIPTION	ELEMENT TIME TMU	CONVERSION FACTOR .0006 LEVELED TIME	% ALLOWANCE	ELEMENT TIME ALLOWED	OCCURRENCES PER PIECE OR CYCLE	TOTAL TIME ALLOWED
1	Get & place plug	51.1	.03066	15	.03565	1/21	.0017
2	Test plug	24.3	.01458	15	.01725	1	.017
3	Plug from & to tester	64.5	.03870	15	.04485	1	.045
						TOTAL	.0637

METHODS ENGINEERING COUNCIL FORM NO. 198

PROPOSED METHOD

DWG. No. A. C. No. 281

PART DESCRIPTION	MATERIAL
Spark Plug	

OPERATION Bomb Test

OPER. NO. 20

LOCATION Spark Plug Unit

OPERATOR

MAN WOMAN	NAME	NO.

EQUIPMENT A. C. Aircraft Bomb Tester

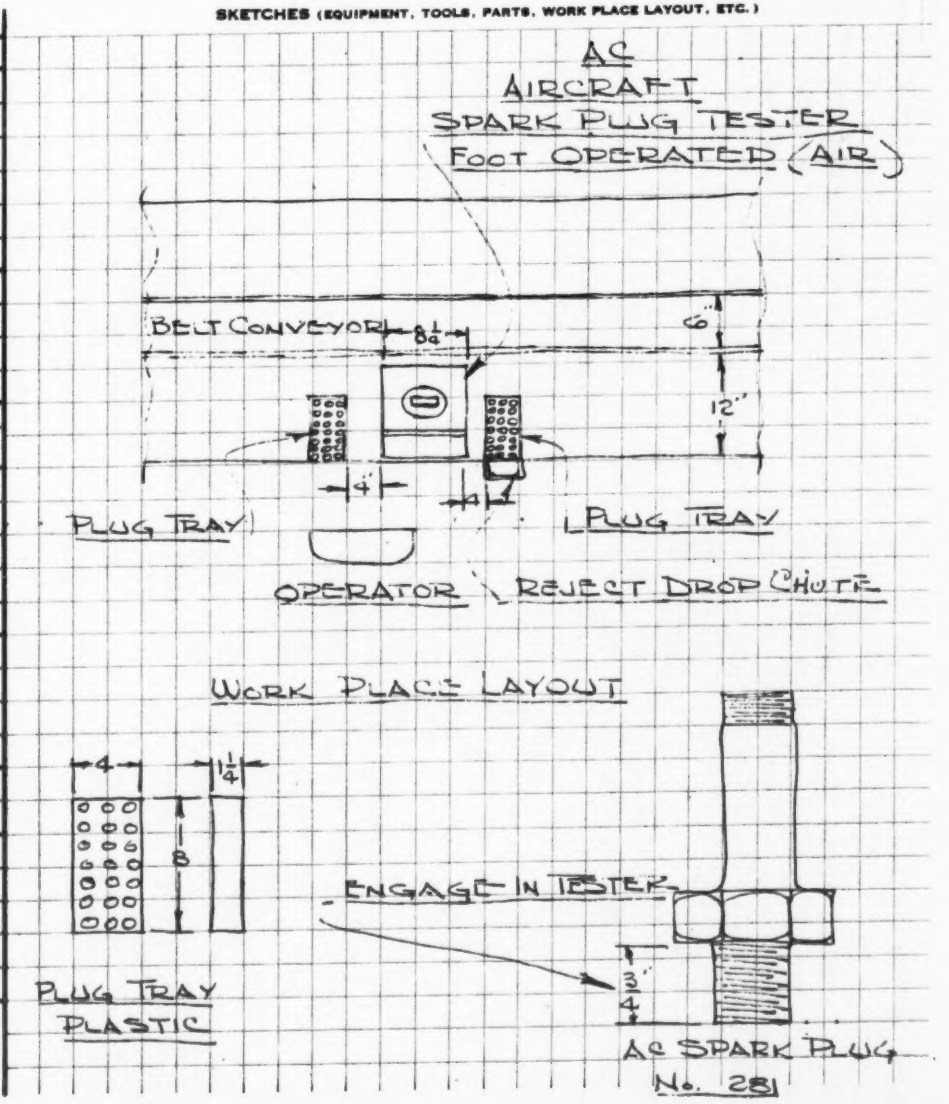
SPECIAL TOOLS None

CONDITIONS Good

QUALITY REQUIREMENTS

STUDIED BY	APPROVED BY
Brauer	

SKETCHES (EQUIPMENT, TOOLS, PARTS, WORK PLACE LAYOUT, ETC.)



PROPOSED METHOD

METHODS ANALYSIS CHART

REFERENCE No. _____

PART SPARK PLUG NO. 281 DATE 1 June 1954 STUDY No. 119

OPERATION Bomb Test ANALYST Brauer SHEET No. 3 OF 3 SHEETS

DESCRIPTION — LEFT HAND	No.	L H	TMU	R H	No.	DESCRIPTION — RIGHT HAND
Element No. 4 (Con't)						
			4.0	DIE		Disengage plug
			13.4	M12B		Move to reject chute
			2.0	RL1		Release plug
			31.0			
Element No. 5 Place Tray On Conveyor (Lower Belt)						
Reach for Tray		R8B	10.1			
Grasp tray		G1A	2.0			
Tray to conveyor		M14B	14.6			
Release tray		RL1	2.0			
			28.7			
Element No. 6 Get Tray From Conveyor (Top Belt)						
			14.4	R14B		Reach for tray
			2.0	G1A		Grasp tray
			17.0	M18B		Tray to bench top
			2.0	RL1		Release Tray
			35.4			

No.	ELEMENT DESCRIPTION	ELEMENT TIME TMU	CONVERSION FACTOR .0006 / LEVELED TIME	% ALLOWANCE	ELEMENT TIME ALLOWED	OCCURRENCES PER PIECE OR CYCLE	TOTAL TIME ALLOWED
	Elements 1, 2 & 3						.0637
4	Reject plug aside	31.0	.00186	15	.002	1/20	.0001
5	Place tray on conveyor	28.7	.01722	15	.020	1/21	.0009
6	Get tray from conveyor	35.4	.02124	15	.024	1/21	.0011
						TOTAL	.0658

METHODS ENGINEERING COUNCIL FORM NO. 198

MTM ANALYSIS

II

BEFORE

AFTER

PRESENT METHOD

METHODS ANALYSIS CHART

REFERENCE No. _____

PART Race - Bearing N. D. #102 DATE 18 March 54 STUDY No. 109

OPERATION Air Dust Race ANALYST Brauer SHEET No. 2 OF ___ SHEETS

DESCRIPTION — LEFT HAND	No.	L H	TMU	R H	No.	DESCRIPTION — RIGHT HAND
			14.2	R14C	1	Reach For Race
			9.1	G4B	1	Grasp Race
			22.1	M20C	1	Move ToAir Nozzle
				~~G2~~		Regrasp Race
			5.6	P1SE	1	Position To Air Nozzle
			34.8	M1B	12	Move Race Around
			15.2	M12C	1	Race To Completed Box
				~~G2~~		Regrasp Race
			2.0	RL1	1	Release Race
			103.0			

IDLE

PRESENT METHOD

NO.	ELEMENT DESCRIPTION	ELEMENT TIME TMU	CONVERSION FACTOR .0006 LEVELED TIME	% ALLOWANCE	ELEMENT TIME ALLOWED	OCCURRENCES PER PIECE OR CYCLE	TOTAL TIME ALLOWED
1	Blow-off Bearing Race	103.0	.062	15	.071	1	.071

METHODS ENGINEERING COUNCIL FORM NO. 188

PER RACE .071 TOTAL .071

PRESENT METHOD

DWG. No. New Departure 102

PART DESCRIPTION	MATERIAL
Race	Bearing
Instrument	Steel
Bearing	

OPERATION Air Blow Off

OPER. NO.

LOCATION Bearing Repair

OPERATOR

MAN / WOMAN | NAME Nell Odem | NO. 5160

EQUIPMENT Air Hose with 1/8" Dia. blow off nozzel and small vice.

SPECIAL TOOLS None

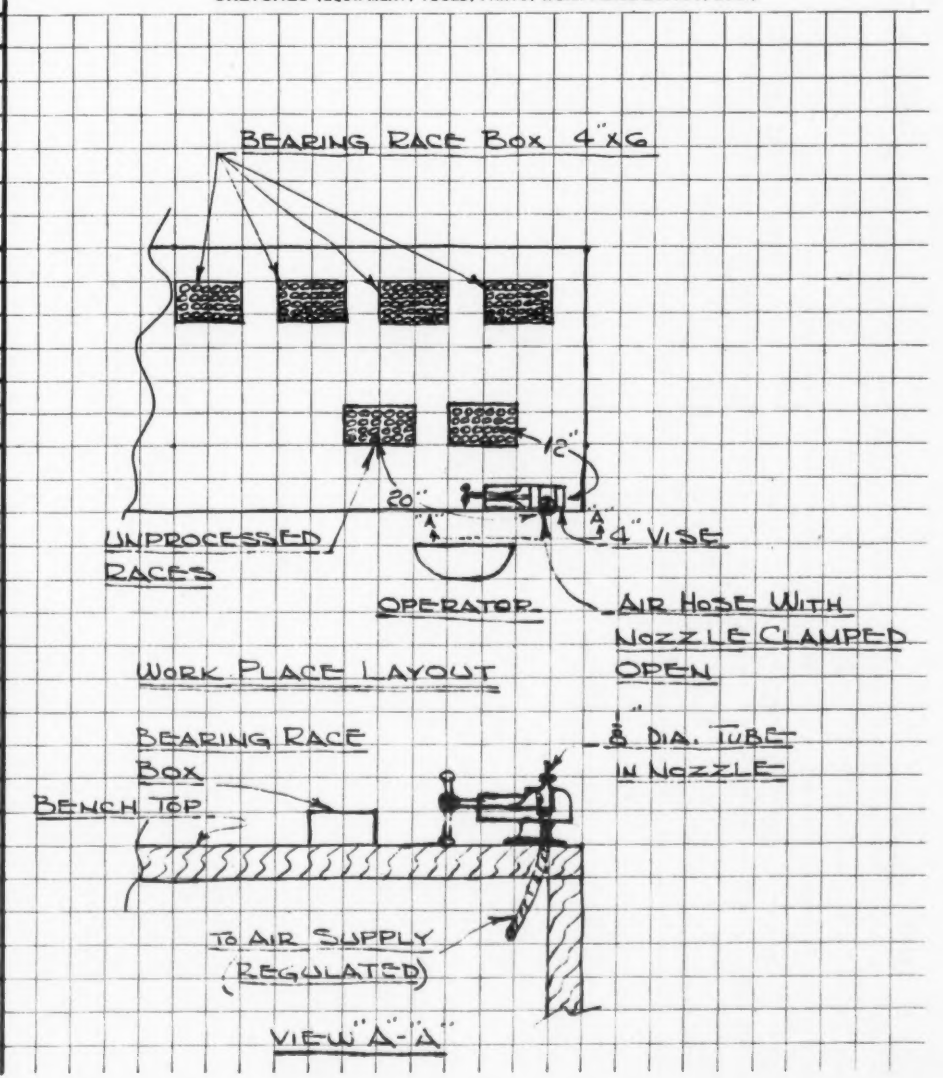
CONDITIONS Fair

QUALITY REQUIREMENTS

STUDIED BY Kramer

APPROVED BY

SKETCHES (EQUIPMENT, TOOLS, PARTS, WORK PLACE LAYOUT, ETC.)



PROPOSED METHOD

METHODS ANALYSIS CHART

REFERENCE No. _____

PART Race - Bearing N. D. #102 DATE 18 March 54 STUDY No. 110

OPERATION Air Dust Race ANALYST Brauer SHEET No. 1 OF 1 SHEETS

DESCRIPTION — LEFT HAND	No.	L H	TMU	R H	No.	DESCRIPTION — RIGHT HAND
Reach For Race	1	R12C	14.2	R12C	1	Reach For Race
			9.1	G4B		Grasp Race
Grasp Race	1	G4B	9.1			
Move Race To Nozzle	1	M12C	15.2	M12C		Move Race to Nozzle
Regrasp Race		~~G2~~		~~G2~~		Regrasp Race
Position Race to Nozzle	1	P1SE	5.6	P1SE		Position Race To Nozzle
			8.5	FM	1	Air Valve On
Move Race Around	12	M1B	34.8	M1B	12	Move Race Around
Race to Completed Box	1	M12C	15.2	M12C	1	Race to Completed Box
				~~FM~~	1	Release Air Valve
Regrasp Race		~~G2~~		~~G2~~		Regrasp Race
Release Race	1	RL1	2.0	RL1	1	Release Race
			113.7			

PROPOSED METHOD

No.	ELEMENT DESCRIPTION	ELEMENT TIME TMU	CONVERSION FACTOR .0006 LEVELED TIME	% ALLOWANCE	ELEMENT TIME ALLOWED	OCCURRENCES PER PIECE OR CYCLE	TOTAL TIME ALLOWED
1	Air Dust Bearing Race	113.7	.0682	15	.0784	1/2	.0392

METHODS ENGINEERING COUNCIL FORM NO. 188

PER RACE TOTAL .0392

PROPOSED METHOD

DWG. No. New Departure No. 102

PART DESCRIPTION	MATERIAL
Bearing Race	Bearing
.625 Dia.	Steel

OPERATION Air Dust Off Race

OPER. NO.

LOCATION Bearing Repair

OPERATOR

MAN WOMAN	NAME	NO.
	Proposed	

EQUIPMENT Twin Air Nozzles

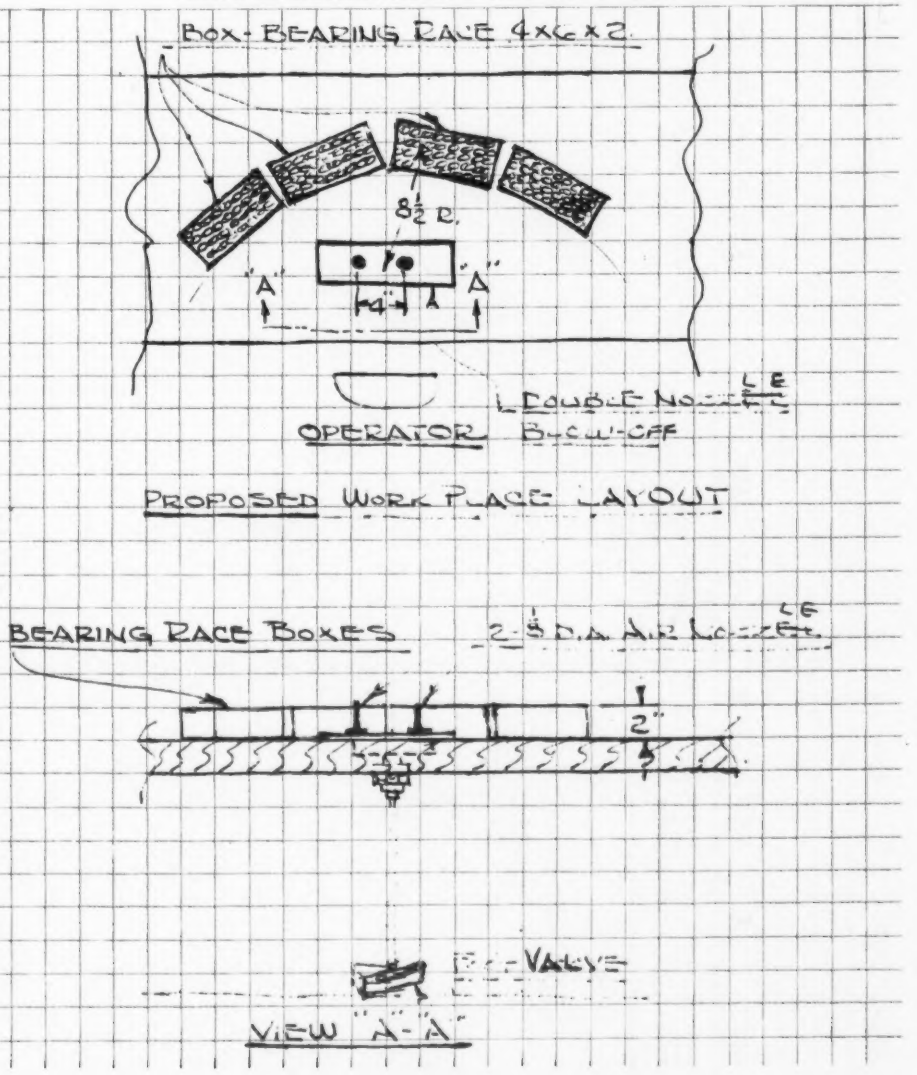
SPECIAL TOOLS None

CONDITIONS

QUALITY REQUIREMENTS None

STUDIED BY	APPROVED BY
Brauer	

SKETCHES (EQUIPMENT, TOOLS, PARTS, WORK PLACE LAYOUT, ETC.)



MTM NEWS

Board of Directors' Meeting. The next meeting of the Board of Directors of the MTM Association will be held March 30, 1955 at the Engineer's Club, New York City.

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Annual International MTM Conference – 1955. The 1955 Annual International MTM Conference will convene October 5th in Chicago, Illinois at the Congress Hotel.

Tentative plans are for three days of meetings with an Introductory Program October 5 and General Sessions October 6 and 7.

Reserve these dates, *October 5, 6, and 7* on your calendar. Plan *now* to attend the informative program, designed to bring *you* the latest developments in MTM.

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Iowa Chapter News. At the Chapter's January meeting Mr. A. B. Lindahl, General Superintendent of the John Deere Des Moines Works, spoke on "Industrial Engineering's Responsibility to Management."

Mr. Lindahl outlined important guide posts for Industrial Engineers. He stated the engineer should:

1. Achieve through knowledge—*Facts*
2. Use *Imagination, Enthusiasm* and *Initiative*
3. Be *Sensitive* to things
4. Have the *Capacity* to be *Concerned*

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Research Project—Moves with Weight. Research Report No. 108—"A Study of Arm Movements Involving Weight"—is scheduled for distribution by March 31st.

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ORDER BLANK – REMITTANCE SHOULD ACCOMPANY SMALL ORDERS

Reports	Quantity	Unit Price		Extensions
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101 Disengage		.75	1.00	
102 Reading Operations		.50	.75	
104 Performance Rating System		.50	.75	
105 Simultaneous Motions		1.00	1.25	
106 Short Reaches and Moves		1.00	1.25	
Proceedings 1952 MTM Conference		2.00	2.00	
Proceedings 1953 MTM Conference		4.00	5.00	
Data Cards				
Detailed Paper				
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			TOTAL	

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Send order to: MTM Association for Standards and Research, 531 East Liberty Street, Ann Arbor, Mich.

RESEARCH REPORTS

Disengage (Report 101)

This report contains a preliminary study of the element disengage. While it is still classified as tentative, the report contains some extremely interesting conclusions on the nature and theory of this element.

Reading Operations (Report 102)

The first step in the use of MTM for establishing reading time standards is contained in this report. In addition, the report contains a synopsis of the work done in this field by 11 leading authorities.

MTM Analysis of Performance Rating Systems (Report 104)

A talk presented at the SAM - ASME Time and Motion Study Conference, April 1952. It contains an analysis of performance rating systems and various performance Rating Films from an MTM standpoint.

Simultaneous Motions (Report 105)

This report represents almost two man-years' work on a study of Simultaneous Motions. It is a final report of the Simultaneous Motions project undertaken by the MTM Association. While it does not purport to provide complete and exhaustive answers to all problems in the field of Simultaneous Motions, it presents a great deal of new and valuable information which should be of interest to every MTM practitioner.

Short Reaches and Moves (Report 106)

This report contains an analysis of the characteristics of Reaches and Moves at very short distances. It develops important conclusions concerning the application of MTM to operations involving these short distance elements.

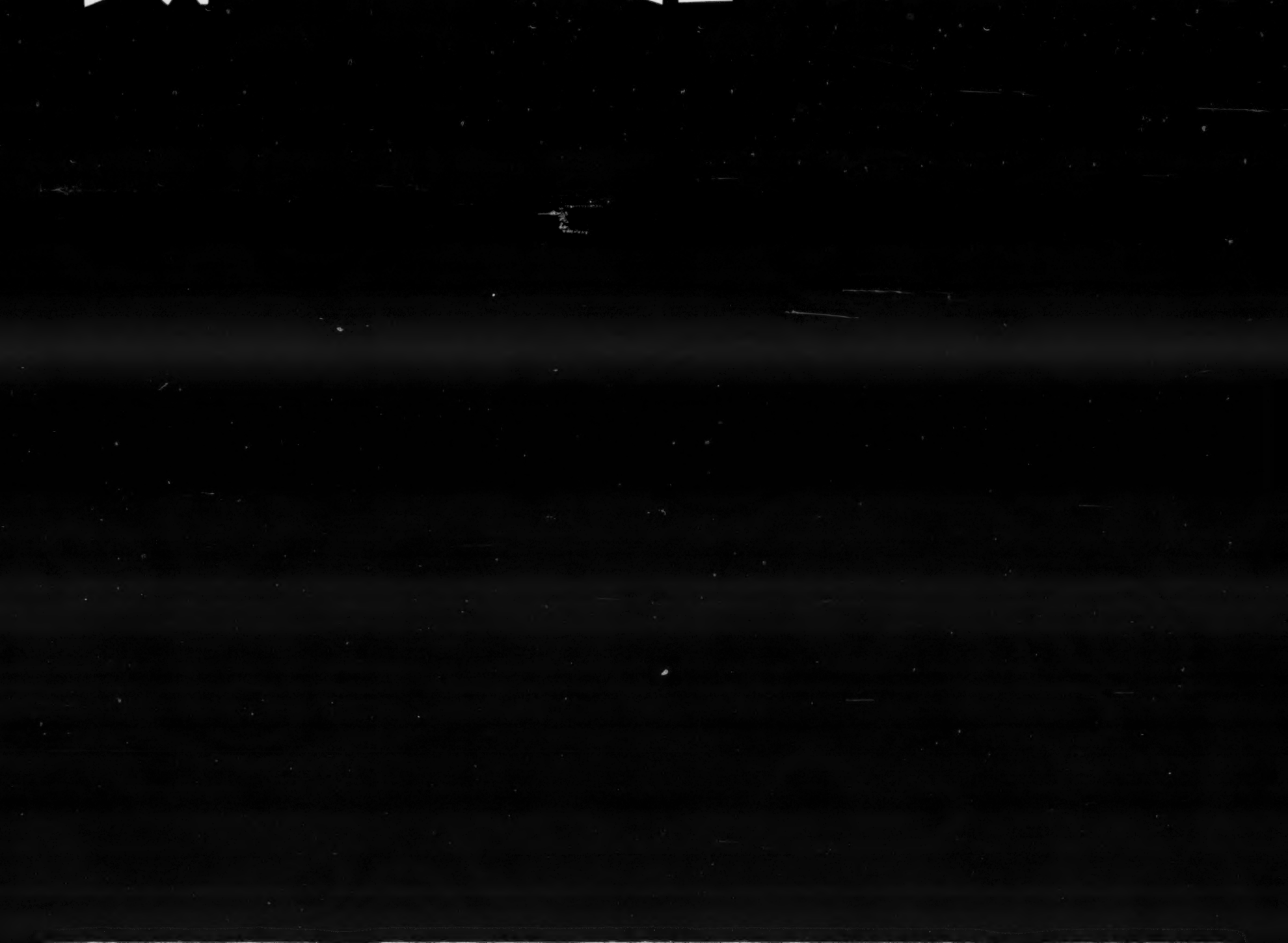
Research Methods Manual (Report 107)

R E S E R V E

These Dates in '55
October 5-6-7

Fourth Annual

INTERNATIONAL MTM CONFERENCE

CONGRESS HOTEL • CHICAGO, ILLINOIS

• INTRODUCTORY PROGRAM OCTOBER 5, GENERAL SESSIONS OCTOBER 6 AND 7
• INFORMATIVE PROGRAM TO BRING YOU LATEST DEVELOPMENTS IN MTM